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Defense Launch:
A Key Dimension of the Promise of Space

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Defense Launch:
A Key Dimension of the Promise of Space

Introduction

> *"The full dimensions of the promise of space are now beyond the scope of our knowledge and our imagination To presume that we have more now than merely a glimpse of those dimensions would be both a vain and perhaps ultimately, a fatally limiting error "*[1]

Lyndon Johnson saw much promise in the U S space program in its early years. As President, he followed the agenda set by his immediate predecessors, Presidents Kennedy and Eisenhower; their long-term leadership is one of the major reasons why the space program is robust today Space continues to offer promise in fulfillment of military, civil and commercial aims but a major limitation on our future capability to exploit its dimensions is an aging launch system

The 1995 National Military Strategy prepared by the Chairman, Joint Chiefs of Staff (JCS), describes how space systems are required as "enhancements" to military power using reconnaissance, surveillance, communications, navigation, weather and other capabilities The JCS envisions a growing role for these systems and this vision is a strength of the Strategy But a major weakness is that modernization "will be pursued only where there is substantial payoff" (NMS, iii)

The need to make a major investment in future space launch capabilities is at the heart of a much larger debate within the Department of Defense on the proper priority for force modernization versus readiness and force structure It is an issue

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[1]Excerpted from a report on the activities of the Second Session of the 85th Congress, delivered by Lyndon Johnson on the floor of the Senate on August 23, 1958

that cuts across the military Services, the Joint level, and affects a wide range of strategic and tactical systems. Readiness and force structure are current priorities that support our military strategy of "flexible and selective engagement" and that enable the United States to answer calls to the Nation's global responsibilities in the post-Cold War era The Strategy reinforces the conventional wisdom that these responsibilities are so vast and so important that they are justified in consuming the majority of resources in a smaller and still shrinking Defense budget. The issue to be confronted later is that few resources are left over for meeting tomorrow's responsibilities

The Clinton Administration's National Space Transportation Policy favors the readiness and force structure side of the debate The Policy includes a hedge to "evolve" the major systems into a new family of launchers while NASA carries out long-term research and development on a new reusable system The program, aimed at lowering costs per launch and improving efficiency of heavy launch in particular, amounts to a postponement of the longer term need

This paper describes the risk of this strategy to our future capabilities It defines the pivotal role of space systems in support of key aspects of our 1995 National Military Strategy, and how in turn, those systems depend on launch It also examines the 1994 National Space Transportation Policy as it relates to Department of Defense needs With a view toward implementing that policy, the paper concentrates on four complex and interrelated dimensions of future launch--force structure, cost, industrial base restructuring and use of foreign technology--that pose specific policy choices that will have decisive influence on the shape of the

future launch program We have the information that we need to make good choices because the Government and industry have already devoted considerable attention to their study. What we need now is strong leadership--such as LBJ provided to the space program decades ago--that will enable us to depart from conventional wisdom and sustain a long-term commitment to the Nations's new goals for"reliable and affordable access " to space The question of future space launch is in essence a question of leadership

National Military Strategy Establishes the Need for Space Systems and Launch

The 1995 National Military Strategy (NMS) includes space systems as "force building enhancements" According to the Strategy, "Peacetime engagement, deterrence and conflict prevention, and fighting and winning our Nation's wars" are the three tasks that our military forces must perform It rests on the "strategic concepts" of overseas presence and power projection (p 1), that rely upon "force building foundations" of quality people, readiness, enhancements, modernization and force balance (p 18-19) Battlefield surveillance, global command and control and the ability to employ precision weapons are among the enhancements upon which the Strategy depends

The role of space systems is likely to grow The former Vice Chairman, Joint Chiefs of Staff, Admiral William Owens, called space systems one of the "emerging instruments of national military power" (Strategic Assessment, 185-193) According to Admiral Owens, an important step toward achieving our military objectives will be to combine three major systems that to date have operated mostly independently

of each other--battlespace awareness, C^3, and those that support precision application of force--into one integrated system Individually, these systems are likely to increase effectiveness of U.S military forces as they reach maturity Collectively, they will ".. permit U S. armed forces to see and respond to every militarily relevant object within a notional theater of operations--a cube of 200 nautical miles on a side With the 'system of systems,' the military will be able to engage in parallel warfare; that is, simultaneous strikes carried out with high precision against targets in widely separated locations "

Space systems provide the global access that is necessary to support such visions. Regardless of function, global access is the singular attribute that makes them valuable.[2] Military space systems as force enhancements have four types of capabilities The first type of mission is reconnaissance and surveillance For the most part the capabilities of these systems are classified but, in general, the systems enable analysts to observe enemies and to monitor specific types of activities such as movements of military forces, missile launches and nuclear detonations A second force enhancement capability is communications Satellites are the centerpiece of the modern command, control and communications network (C^3) and support long-haul, theater-to-National Command Authority, and inter-theater communications For example, during DESERT STORM, all communications into and out of the theater were via satellites, as was up to 85% of the communications within the theater (Keethler, 379). The world saw in 1991 that, not only did use of

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[2]The principal constraint upon global access are the laws of physics See Space Handbook An Analyst s Guide, Volume Two (Air University Press, Maxwell Air Force Base, Alabama) for an explanation of these laws and their relationship to orbital mechanics

space make instant communication possible, it made it a military imperative Limitations on communications capacity is thus one of the most important issues today in terms of support to military operations Navigation is a third force enhancement. Global Positioning System (GPS) is 1970s technology originated by the military that provides precise targeting to guide jets, missiles, and ships anywhere on earth, and was a key component of the U S ground and air offensive in the Persian Gulf war. This technology has matured and is credited with increasing importance Recently, the Clinton Administration announced its decision to provide the full precision available to civilian uses (Mintz)[3] A fourth enhancement is weather data Data from these satellites can help support the launch, route, target and recovery portions of a wide variety of strategic and tactical missions Reliable weather data is a longstanding and critical element of military planning and execution

In addition, there are enhancements available to U S military forces that stem from military use of civilian systems Civil space offers military space consumers additional communications for surge requirements, weather monitoring and multispectral remote sensing[4] Remote earth sensing is a capability whose

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[3]Before this policy was announced, civilians had to settle for less precise positioning data that was deliberately "dumbed down" to deny the capability to those with hostile intent The Clinton Administration approved the change to enable U S firms to take advantage of the commercial potential of such technology even recognizing that there is some security risk associated with such a policy

[4]Conversely, the military space systems offer useful capabilities to the civil sector--especially navigation, weather monitoring and communications

military application is growing It is based on multispectral imagery, originally a scientific tool, that maps the earth's surface and topography Its data supports military operations with terrain analysis and other characterizations of surface conditions that indicate mobility It also provides some broad-area surveillance The United States' LANDSAT and French SPOT programs are two examples of such systems. The military also uses some civilian radars for space surveillance All of this data helps military commanders make decisions that support peacetime functions and to help them prepare for and execute war Policymakers are faced with the dilemma that, now that satellites are coming of age, these very systems are being reduced to satisfy demands to reduce the Defense budget.

Force enhancement is not the only space mission Space control, space infrastructure, and in the future, force application (or space combat) are additional missions However, there are currently no space weapon systems under development. If the United States were to deploy such means, it would dramatically change the character of the military uses of space and the need for space launch Failing such a development, force enhancement will remain the dominant requirement for space launch

All the force enhancement missions carry with them a demand for space launch The different types of space payloads have different requirements for launch Expressed qualitatively, the DoD requirements for launch are·

- *Assured access* The strategy of "flexible and selective engagement" recognizes global responsibilities for the United States (although its implementation is envisioned as regional) and the ability to fight two nearly simultaneous Major

Regional Conflicts (MRCs) is based on the availability of "space capabilities to support a wide range of activities in peace and war" (NMS, ii-iii) Space systems need to provide global access in support of military operations, and space launch must assure this requirement can be met with varieties of orbits, in various configurations of constellations and at altitudes appropriate to the systems being deployed.

- *Timeliness and responsiveness* Although the launch of military satellites was never intended to be tactically responsive capability, there is general consensus that the timelines associated with many classes of launch are far too long (National Research Council, 19) This is one of the major issues that will be discussed below

- *Flexibility* DoD needs the ability to launch light (less than 4,000 lbs), medium (4,000-20,000 lbs.), and heavy payloads (40,000-60,000 lbs) into various orbits, including low-earth orbit (LEO), geostationary orbit (GEO), and highly elliptical orbit (HEO).[5] The need for very heavy lift (135,000-600,000 lbs) is speculative,[6] but might be required to support the deployment of space segments of a national missile defense system Quantitatively, DoD payloads dominate the U S

[5]The vast majority of satellites are launched into either LEO or geostationary orbit The LEO orbit occupies a large band that spans altitudes from 150 to 500 miles above the earth Many commercial and scientific satellites occupy the LEO orbit, as do weather satellites and remote sensing satellites Some surveillance satellites also operate in this orbit, while navigational and military communications satellites operate either slightly above or below the outer fringes of LEO The geostationary orbit is a narrow band about 22,300 miles above earth and enables satellites to remain essentially fixed over a spot on the equator at all times It is used principally for communications satellites that relay signals to ground stations This spatial location is limited in the availability of "slots' and is therefore an area of commercial, legal and strategic contention

[6]In addition, NASA foresees a need for very heavy lift to support deployment of a space station

requirement for space launch and they will continue to dominate it for the foreseeable future The Department of Defense[7] estimated a demand for an average of about two small, eight medium, and three heavy launches per year between 1995 and 2010[8] (OTA-ISS-620, 88)

The Dimensions of Space Launch

The1994 National Space Transportation Policy (NSTP, See Appendix) states that ". the U S space program is critical to achieving U S. national security and foreign policy goals Assuring reliable access to space is a fundamental goal of the U.S space program" How to design a space launch program that provides "reliable and affordable access" is a complex and multidimensional subject that has been intensively studied in recent years This section reviews four major dimensions of these goals--force structure and modernization, cost, industrial base, and use of foreign technology--explains why these are important factors in space launch and evaluates their relationship to the NSTP goals These dimensions are closely interrelated with each other--each dimension shapes, and is shaped by, the other three. Individually and collectively they have short- and long-term implications on our ability to launch with assured access, timeliness and responsiveness, and flexibility The following discussion will show the importance of modernizing

[7]See U S Department of Defense, Office of the Deputy Assistant Secretary of Defense, "Industrial Assessment for Space Launch Vehicles," Washington, D C , January 1995, p ES-1

[8]In 1994, DoD launched 5 small payloads, 4 medium payloads and 4 heavy payloads These 13 launches constituted 48 percent of the total of 28 U S launches There was a total of 94 launches worldwide that year

space launch.

Force Structure and Modernization Issues

The current launch force comprises the Delta, Atlas, and Titan space launch vehicles[9] (See Table at Appendix) All of these were developed for DoD based on Inter-Continental Ballistic Missile (ICBM) technology NASA vehicles include the Scout and Saturn (no longer produced), and the space shuttle All vehicles except the shuttle are expendable launch vehicles (ELVs), so named because they can only be used once

The DoD added to its fleet following the shuttle *Challenger* disaster in January 1986. For a period of time before then, both DoD and NASA were slated to use the space shuttle After the shuttle explosion, the Air Force convinced Congress that the nation needed a "complementary" ELV to avoid reliance on a single system and to allow DoD to launch its payloads into space expeditiously This was the beginning of the Titan IV launch program

The 1994 National Space Transportation Policy stipulates specific functions and limitations on that force structure

• DoD is the launch agent for the national security sector (and will maintain the capability to evolve and operate those space transportation systems, infrastructure and support activities necessary to meet national security needs),

[9]In addition, the DoD fleet includes the Pegasus, an air-launched vehicle built by Orbital Sciences Corporation

• U S Government payloads will be launched on U S vehicles for the foreseeable future, unless exempted by the President,

• Excess ballistic missile assets (eliminated under the START treaty) are not to be used unless specifically approved by the Secretary of Defense,[10]

• DoD will continue to use the Titan IV heavy launcher until a "replacement can be made available", and

• NASA will develop technology to be applied to a future Reusable Launch Vehicle for both DoD and NASA

The DoD force structure is quantitatively adequate to meet projected DoD launch needs, but is qualitatively deficient (National Research Council) In light of this, the NSTP directs DoD to develop a new family of expendable launch vehicles, known as the Evolved Expendable Launch Vehicle (EELV)

The EELV concept originated in a 1994 DoD "Space Launch Modernization Plan" study [11] The study's premise was that space transportation was unreliable and too costly DoD was spending about $1 9 billion per year for space launch services--

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[10]This is an issue that DoD has studied for some time There is some consensus that excess ICBMs may be valuable resources for either conventional warhead delivery or for space launch There is no political consensus that they should be used in this fashion

[11]Familiarly known as the "Moorman Study" after Air Force General Thomas Moorman, who headed a study team, this study was prepared in response to a mandate in the 1994 Defense Authorization Act The report built on previous studies, including the 1990 Augustine Report, the 1992 Aldridge study, DoD's "Bottom-Up Review" in 1993, and NASA's "Access to Space Study"

approximately $1 6 billion of which was used to support the Titan IV program [12] For this reason DoD chose to focus on reducing the cost of launching heavy payloads as its first priority The EELV program entails consolidating the medium- and heavy-lift rockets into one family of vehicles, flying current launch vehicles already on contract and lowering operations costs by increasing production rates According to the study, the projected costs per heavy-lift launch were estimated at $100-150 million and $50-80 million per medium-lift flight and the program investment costs were estimated at $1-2 5 billion (OTA-ISS-620, 29-30)

In addition to the EELV, the study panel considered three other options One was to sustain existing launch systems (at $50-125 million per medium and $250-320 million per heavy-lift flight), another was to develop a new expendable launch system ($40-75 million per medium lift flight, $80-140 million per heavy lift, with additional cargo costs of $130 million or personnel costs of $90-190 million per flight if the vehicle were to serve NASA needs as well), and the last was to develop a new reusable launch system (cost per flight not estimated)

The "Space Launch Modernization Plan" recommended that DoD continue to use the Titan IV launcher) but to "evolve" the current medium- and heavy-lift launch systems to the EELV to reduce the cost of using the current systems That recommendation was included in the National Space Transportation Policy because the new program has lower estimated costs per launch than current systems and the upgrade can be carried out with relatively low program investment costs That

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[12]See OTA-ISS-620 According to OTA, the Moorman Panel calculated that the remaining $300 million is spent primarily on medium-lift vehicles, and some on light-lift

approach emphasizes meeting current needs, limits near-term investment outlays but also limits the modernization Perhaps easier to implement in the short run, the approach entails long-run risks

Andrew Krepinevich, former Assistant to the Director of DoD's Office of Net Assessment and Assistant for Special Projects on the staff of three former Secretaries of Defense, has looked at these long-term issues In his recent article "Recasting Military Roles and Missions," Dr Krepinevich argued that maintaining readiness and force structure absorbs funds that could be applied to solving our strategic problems and enhancing long-term flexibility He further argued that emphasis on readiness encumbers force structure with large quantities of defense capital stock during a time of rapid technological change This "limits the ability of U S forces to experiment with emerging military systems, new operational concepts and different organizational structures that may prove far more capable than their counterparts of today " Using Dr Krepinevich's arguments, the EELV choice can be viewed in a different light, namely launch force modernization is being traded for short-term budget and operational readiness considerations However, the "Evolved" fleet will suffer the same basic ills as the current fleet, i.e , technological obsolescence, unresponsiveness and high expense.

Cost

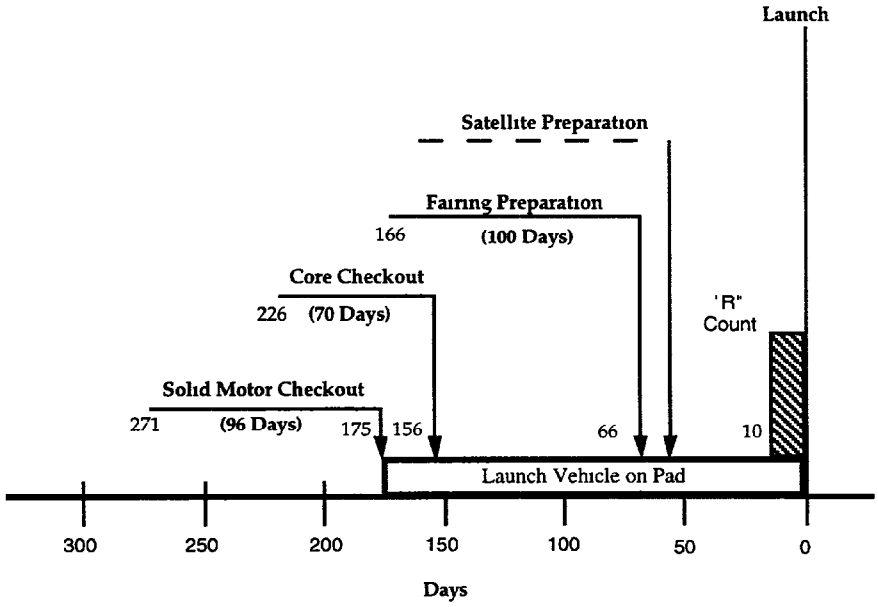
Numerous recent space launch studies have concluded that reducing launch costs is one of the two most important issues for the Nation to address [13] This is

[13]The other issue is improving operability, discussed in section on industrial base issues

because launching payloads to low-earth orbit costs from $3,000 to $10,000 per pound of payload, and placing them in geosynchronous orbit can cost up to $20,000 per pound (OTA-ISC-415). One of the major factors contributing to the high cost of launch is that current launch vehicles are based on 25-to-40 year old technology High costs pervade the launch system the infrastructure to support the vehicles is old, deteriorating, inefficient, highly specialized and, as a result, expensive to operate (National Research Council, 15)

Another cost factor is customization For current ELV launches, each payload and vehicle combination is a custom assembly, which is optimized and adjusted within available margins at the expense of schedule, flexibility and reliability (NRC, 15) [14] As shown below, this effort may tie up a launch pad for up to one-half year.

Titan IV Processing Flow (West Coast)



Source Kelly p 9

[14]Reinforcing this is the DoD acquisition mindset that emphasizes performance over cost (Sutton, 138)

It is a significant tradeoff to allow the exigencies, or perceived exigencies, of engineering to interfere with the economic needs This has directed attention to the cost of operations and support and how launch vehicle and payload designs interact

Launch prices are not the only major cost Another factor is the cost of launch as a function of total cost of space systems That is to say, it costs much, much more to build a spacecraft than to pay for its launch to orbit, and unless spacecraft costs are reduced, even dramatic reductions in launch costs will have only a small effect on total program costs (OTA-BP-ISC-60, 1) In addition to satellites and launch, costs for storage and preparation for launch, ground station receive and tracking equipment, and on-orbit costs are high [15] It is because the total system costs are extraordinarily high that every launch is a critical one

In addition to cost-per-launch and total system costs, life-cycle costs of the launch systems are an additional criterion In a recent study prepared by the Office of Technology Assessment (OTA-ISC-415), OTA evaluated the potential merits of proposed and existing launch systems according to their life-cycle costs, i e the total of non-recurring costs and recurring procurement and operating costs Importantly, the data showed that the benefit of any life-cycle cost of any vehicle depends on the future demand for space launch This means that the differences in life-cycle cost among newly developed versus upgraded and modified existing systems versus existing systems are small if growth in demand for launch services is low[16], but the

[15] Further, commercial purchasers of launch services includes costs for insurance and other non-price factors such as scheduling, reliability and payment plans are equally important to commercial users (Hertzfeld, 212)

[16] Especially when compared to the cost risk of developing a new system

cost estimates favor investment in a new system if future demand increases. This is especially true of the expensive heavy cargo launch systems (p 14) From this perspective, the long-term benefits of investing in a new system depends upon that system meeting both government and commercial future demand [17]

It is only recently that economic and commercial concerns have risen in priority in U.S. government decisionmaking concerning military launch In addition to national security objectives, the Nation has traditionally placed great value on other policy objectives such as employment, national prestige and maintaining the domestic scientific knowledge and resource bases The issue is not whether these are justifiable in and of themselves, but whether they are compatible with national security and economic objectives in support of the space launch program. To a large degree they are not Thus, the Nation first needs to answer the question whether it is its national security interest to develop a cost-effective Defense launch program, and separately, whether the United States should be internationally competitive in commercial launch services The OTA life-cycle cost analysis suggests that future Defense and commercial goals for access to space can be mutually supported by developing a modern and cost effective launch system (if future demand is sufficiently high) The ability to develop such a system depends on the ability of the launch industry to do so, which is the next dimension to which we will turn

[17]The future competitiveness of U S launch is a large subject in its own right that cannot be undertaken here Both Government and industry recognize that future demand for commercial launch is uncertain, the investment is large and the risks are high See Hertzfeld, Henry, "Economic and Commercial Dimensions of International Launch Vehicle Competition" in Papp and McIntyre for an excellent discussion of this broad subject

Industrial Base

The effectiveness and vitality of the Defense industrial base as a whole is a major concern now, and will continue to be, with regard to America's future strategic posture The Government wants to accomplish three things in restructuring the industrial base First, it wants to change the performance, configuration or size, and make other modifications to the infrastructure that result in a more capable industry Second, it wants to shape the base consistent with those industrial and technological trends that will be dominant factors in shaping the industrial base with or without government intervention Third, and most importantly, it wants industry to produce systems whose capabilities provide greater strategic and operational payoffs that will offset the reduced availability of Defense funds in the future [18]

In general, the Government's aims for the launch industrial base fits within this broader set of aims It is a complex case study that has received much attention in recent years.[19] But the U S. launch industry is shaped by the fact that the U S Government is the largest customer for its products and services and some industry officials believe that the Government demand is insufficient to sustain some parts

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[18]There are additional factors from diverse sources that are influencing the future complexion of the industrial base Among these are growing levels of industrial regionalization and globalization, and the interdependence among nations and firms within industries regardless of nationality, the abundance of cheap labor overseas, the shortening of the technology life cycle, whether reliance upon exhaustible resources such as oil will continue, ecology, and others (Foster, 133-134)

[19]Indeed, there are many recent studies on this large subject See DoD s "Industrial Assessment for Space Launch Vehicles" (January 1995) and the "Space Launch Modernization Study" (1994), the Vice President's Space Policy Advisory Board study titled "The Future of the U S Space Industrial Base" (1992), and the U S Congress Office of Technology Assessment's "The Lower Tiers of the Space Transportation Industrial Base" (1995)

of the industry over the long run (OTA-ISS-620, 24) A further area of concern is whether the United States should invest in a commercial launch industry to sustain an industrial base if the systems produced by it are principally designed to support Government needs If it is redesigned to support commercial needs, there is concern as to whether the commercial, Defense and non-Defense Government needs will compete for resources within that system. As noted above, the future demand for commercial launch is uncertain, the investment is large and the risks are high Another school of thought says that the Government demand for launch is large and important enough to sustain a viable launch industry (OTA, 24)

The NSTP specifies that the Government will want to make the development and operation of new launchers more affordable (whether the launch industry is eventually restructured to support the Government or whether it supports both Government and commercial interests) As important as reducing costs may be, there is, however, a more important goal that the Government should seek The goal should be to achieve "unity of effort" (Foster, 136) Launch unity of effort would achieve coherence, reliability, and responsiveness across launch vehicle production and would integrate production efficiencies with efficiencies in launch operations Although there is very close collaboration between the Department of Defense and launch companies (and their respective contractors), the process is not efficient Returning to the Titan IV Processing Flow Diagram for West Coast launches, the specific pad is occupied beginning about 160 days before the launch for checkout of the solid motor (96 days), the checkout of the core (70 days), preparation of the fairing (100 days) and finally, preparation of the satellite on the launcher takes

place some sixty days before launch.This is a major operational inefficiency that should be eliminiated in the process of industry restructuring and developing a new family of vehicles

The NSTP does not directly address launch industrial base issues It specifies a closely related requirement to maintain the U S technological edge (p 1) in launch vehicle production and services The emphasis on technological superiority is somewhat off the mark. Instead, the Government should aim for "comparative operational advantage" or attaining a "total system edge" (Foster, 143) This is because technological advantages are never absolute, are often marginal and transitory, and are seldom controllable Mr Foster, a faculty member of the Industrial College of the Armed Forces, argues that a more dominant factor in the long run is system integration that matches technology to operational needs Total system capabilities will be especially powerful if combined with frequent and dynamic application of doctrine, force structure, technology, manpower, training and education and logistics support--a lesson that History has taught the United States and other countries many times on the battlefield It is this end-to-end concept of the smaller and restructured industrial base that is most likely produce launch systems whose capabilities provide greater strategic and operational payoffs that will, in fact, offset the reduced availability of Defense funds

Perhaps equally important as a political than an industrial base issue, is that future launch capabilities and the industry should be tailored to strategic, rather than bureaucratic, goals. The decision to proceed down two separate paths for the near-to-medium term for NASA manned space transportation needs (using

reusable launch vehicles) and DoD cargo transportation needs (using ELV and EELV) is based on operational need. Both industry and the government believe that no single system, whether expendable or reusable, can meet all projected requirements (OTA-BP-ISS-161, 25) However, it is not clear that there will be sufficient funds to make the significant long-term investment that is required in both segments of the same industry that will be developing new launch systems based on radically different technologies The functional separation created by the 1958 National Aeronautics and Space Act has resulted in bureaucratic competition between the two agencies, and it is likely that each agency will argue for tailored capabilities as they have in the past Even though the NSTP directs that NASA and DoD "will combine their . requirements into single procurements when such procurements will result in cost savings or are otherwise advantageous to the Government" (p 2), longstanding bureaucratic politics may dictate separation notwithstanding advantages to the Government If separation is allowed to persist where needs are in fact similar, this may have the effect of reducing economies of scale and undermining the future agility of manufacturing methods within the industry (Foster, 147).

Use of Foreign Technology

The "internationalization" of space began in 1970, when Japan and China developed capabilities to place satellites in orbit. The pace of internationalization has been accelerating ever since, with a successful *Ariane* launch vehicle test under the auspices of the European Space Agency (ESA) in 1979, followed by India, Brazil

and China developing indigenous launch capabilities[20] The U S Government first embraced internationalization with the Reagan Administration space policy in 1986[21] That policy recognized that it is "less and less appropriate to make space policy in isolation from the broader agenda of international commerce and foreign affairs" (Papp and McIntyre, 4) The Reagan Administration policy sought to use internationalization to share the high costs of space research, and second, use space as an instrument to further diplomatic goals

The 1994 NSTP is weaker than the Reagan Administration policy in this regard The Clinton Administration launch policy stipulates that federal departments and agencies "will seek to take advantage of foreign components or technologies in upgrading U S space transportation systems or developing the next generation of space systems " It gives a nod to the growing interdependence of space activities by allowing launch of government payloads on foreign launch vehicles that are made available on a "no exchange of funds basis" to support flight of scientific instruments on foreign spacecraft, international scientific programs, or other cooperative government-to-government programs but it also specifies that U S national security payloads must continue to be launched on U S launchers The policy allows, for example, use of non-U S launch vehicles during construction and operation of the international space station but, in the final analysis, doesn't tread very far onto international space turf

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[20]See Katz, James Everett, "New Directions Needed in U S Space Policy," in Papp and McIntyre The internationalization of space is one of several trends that have changed the complexion of space since the United States and the Soviet Union first entered the then-new frontier in the early 1960s

[21]The other major trends embodied in the 1986 space policy were privatization, commercialization and militarization

The United States has invested relatively little in developing new ELV technology, whereas foreign countries have invested considerable amounts in launch systems in recent years (NRC, 13) A policy that actively encourages--or mandates--use of foreign technological innovations could offer to U S manufacturers a wider range of design possibilities from which to choose, most of which should have been tested, and in some cases, implemented Incorporation of foreign technology might increase launch vehicle performance and reduce costs On the other hand, if the use of foreign technology were to reduce the amount of R&D on the part of U.S firms, there is an argument to be made that it might also undercut long-term innovation in some areas But affordable access to space is an explicit National Space Transportation Policy priority The United States should therefore take advantage of opportunities to purchase foreign technology, components and even complete systems where they are more cost effective With the emphasis on affordability, it is more important to have access to technology (and components, subsystems, etc) regardless of source than to maintain capabilities in certain "critical" technologies and processes

U.S firms could adopt several approaches to using foreign technology to save development costs One approach is to buy components or systems directly from foreign suppliers (OTA-ISS-620, 70). This would most likely be a highly charged political issue as lost jobs for U S. workers Alternatively, a U S firm could buy a licence to produce a given component or system based on a foreign technology (OTA-ISS-620, 70). This would have the effect of increasing domestic employment In addition, access to foreign components--and particularly systems--could provide a

strategic benefit if other nations of the world were to have capabilities that might be considered redundant to U S systems The availability of an international reserve capacity might prove to be an advantage to the DoD in the event of another launch disaster.

In the end, the United States must become more flexible and make use of foreign technologies and components if the DoD is to lower its costs and the country is to be competitive internationally in launch services. The NSTP is worded such that the United States "*will seek to take advantage of* foreign components or technology" This wording is not strong enough to compel the use of foreign technology, components and systems where it is cost effective

In fact, DoD is willing to use launch systems that have foreign components and technology, but only if foreign suppliers are not on any "critical path" that could deny access to space. An example of this is an offer from the European Space Agency to provide (under various possible arrangements) the *Ariane 5* heavy-lift launcher as a candidate for DoD Evolved Expendable Launch Vehicle program, on the premise that the United States could avoid a costly development program That proposal was received with little enthusiasm [22] Another possibility for heavy lift is the Russian *Energia* launcher From a technology perspective, the use of Russian systems might be particularly beneficial Their strength lies in propulsion technology and rapid payload processing and integration Proposals such as these merit due consideration

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[22]Ben Ionatta and Cheri Privor, "Arianespace's EELV Proposal Finds Little Favor," Space News, April 10, 1995, p 3

In summary, "reliable and affordable" access to space is a complex problem Reliability and affordability depend upon factors beyond cost-per-launch, but these costs also depnd upon access to cost-effective components and technology and an industrial base that allows system design and operations to be efficient and tightly integrated All point to the need to modernize the space launch system The ability to implement a modernization further depends on factors discussed below

Additional NSTP Implementation Issues

History of inaction A major concern of industry and government analysts is that the country has a long history of false starts or inaction on space launch programs Numerous government surveys, studies and committees have reviewed the issues concerning, military, commercial and civilian space, and have made recommendations to the Executive and Legislative Branches A recent example, is the Bush Administration's "The Vice Presidents' Space Advisory Board Report" and the "Final Report to the President on the U.S Space Program" that recommended developing a new family of launch vehicles The joint DoD/NASA Advanced Launch System that resulted from the Report was cancelled at the direction of Congress in 1993 Later, plans to develop a medium-sized ELV known as "Spacelifter" were scrubbed due to budgetary needs (Radzanowski and Smith, 5) NASA programs have faced a similar history This history of cancellation and inaction is particularly worrisome in light of constraints on DoD spending that are greater now that at the time previous programs were abandoned Any continuation of the trend bodes poorly for EELV and very poorly for any program that may

develop from NASA's longer-term technology development effort

Decreasing Defense budgets The U.S government's recent annual commitment to military space is about $13 5 billion in FY 1995 (Smith 95-95 SPR, 1) which includes satellites, launch vehicles and associated equipment and facilities Perceived in the Congress as a large amount of money, the space budget has come under scrutiny, as have other large Defense programs "Cutting the space budget is a relatively safe decision compared to cutting spending on programs of direct concern to constituents . Developing an investment strategy will be very hard considering tight budget situation," according to Richard DalBello of the White House Office of Science and Technology Policy (Lenorovitz) A key question is whether we will sustain the long-term financial commitment to developing a new military launch capability--both vehicles and infrastructure--in the face of domestic economic pressures

Lack of support for space launch programs Unlike manned space exploration, DoD space launch is little known to the public and has relatively little public appeal (Johnson-Freese and Moore) Within the Government, its support is fragmented within the Executive and Legislative Branches Various Congressional committees and subcommittees are strongholds of support for space programs but Congressional support for space is impeded by concerns about budget deficits, holding down federal spending, and diverting resources from competing, especially social, programs (Katz, 55) For their part the aerospace companies have attempted to minimize the likelihood of budget cutting as a political exercise Several have

banded together and have formed the Space Launch Advocacy Group, founded by a Vice President for Advanced Launch Systems at Lockheed-Martin, to elevate issues of concern for attention by Congress and other Government decisionmakers Members of the launch industry believe that the United States has not adequately defined its goals in the space launch field, and that reaching a consensus on these goals is a fundamental precondition to specific measures to preserve the space transportation technology and industrial base (OTA-BP-ISS-161, 25) Also, the conflicts and competition for resources between DoD and NASA provide a tenuous basis for political support within the Executive Branch Overall, there is little likelihood that any aspect of the program can be accomplished without a strong domestic consensus

Lack of space policy and doctrine. Finally, although the 1994 National Space Transportation Policy is a positive statement of Government aims, it is not a sufficient basis on which to link launch policy to broader space goals The last comprehensive National space policy review was conducted by the Bush Administration (*Final Report to the President on the U S Space Program*, January 1993), and from it flowed a series of Space Policy Directives [23] The Clinton Administration has not undertaken to define its broad goals or to link specific space program goals together In turn, the void in guidance at the National level has cascaded down to Defense Department Moore, Burdura and Johnson-Freese note

[23]The subject of these directives includes National Space Policy (NSPD 1), Commercial Space Launch Policy (NSPD 2), U S Commercial Space Policy Guidelines (NSPD 3), National Space Launch Strategy (NSPD 4), LANDSAT Remote Sensing Strategy (NSPD 5), Space Exploration Initiative Strategy (NSPD 6), and Space-Based Global Change Observation (NSPD 7)

that there is no joint space doctrine and they argue that the doctrine is needed so as to "...provide priorities by offering a coherent vision for employing space forces that significantly enhances national security Clear goals will help in determining the requisite tools (force structure and equipment) for this task (p 72) " Also, as noted above, the combination of operational efficiency and dynamic application of doctrine, force structure, technology, training and other factors is powerful when they come together on the battlefield We need to plan now to take maximum advantage of space systems as instruments of military power

Conclusion

The 1995 National Military Strategy ascribes an important role to space systems as "enhancements" to our military capabilities to engage in a wide range of peacetime activities, deter aggression and prevent conflict, and fight and win wars In the not-too-distant future their role as instruments of military power is expected to increase This emphasis on capabilities that enhance power projection and use of emerging technology is a strong point of that document But the emphasis that it places on force readiness at the expense of modernization ("only where there is substantial payoff") is a great weakness

The 1994 National Space Transportation Policy is the only Clinton Administration statement on space policy to date, and to its credit, the policy addresses a vitally important need It places priority on "reliable and affordable access to space," a policy that directly supports what is "fundamental" in the JCS Chairman's terms, to the National Military Strategy Like the Strategy, the NSTP

places greater value on readiness and force structure than on modernization of the launch fleet.

The Evolved Expendable Launch Vehicle (EELV) program is designed to lower costs and improve the reliability of our medium--and especially heavy launch --systems because these consume the vast majority of current Defense launch expenditures If the EELV program is brought to completion, it may help the country to reach our near-to-medium term technical and policy goals, that is, to improve the efficiency and operational flexibility of each space launch and to reduce costs per flight.

The much greater issue concerns the long term This review of these issues has shown the EELV program does not address the more fundamental structural inefficiencies that pervade the aging launch system to include pads, operations and vehicles The restructure of launch industrial base must be done in such a fashion that program costs are reduced and efficiencies across the vehicle development-to-launch-operations cycle can be found and exploited The design of future launch systems, whether expendable or reusable launch vehicles, must be done in tandem with the restructuring of the industrial base. The use of foreign technology, components and systems supports both short- and long-term cost objectives The launch industry and U S launch programs must be flexibly designed so as to make more extensive use of these; our foreign and Defense policies must support and reaffirm this objective

The Nation's ability to field a modern and efficient space launch system depends upon many factors In the final analysis, none of them is as important as

leadership Among the broad issues for DoD to decide is whether the Nation can continually afford to invest in today's readiness and force structure and postpone modernization, which is tomorrow's readiness and force structure Also at the top level, the White House--the traditional power base for space policy--must develop broad space goals and actively seek public support for them To this end the Clinton Administration should initiate a National dialogue on the space program, not only to develop political consensus for its goals but also procedural consensus on its implementation Whether public support can be translated into budgetary commitments is uncertain But the budgetary commitments that this program requires are large, and are not likely to be made, let alone sustained, in the absence of public support.

DoD military and civilian leaders (and the leaders of other Agencies with a stake in space launch) have an indispensable role to play in generating support for launch modernization They should illuminate the key issues for the White House and the public and help set the terms of the debate They also have the major role to play in detailing Defense needs for members of Congress Finally, it is important that they work with aerospace companies and other interest groups on implementation issues. The DoD leadership has the opportunity to shape our future space launch posture so that it reliably supports the Nation's security goals

We now have a clearer understanding of the dimensions of space of which Lyndon Johnson spoke almost forty years ago At that time his concern was that we not limit our imagination lest we limit the promise Now, the fatally limiting error would be to fail to act on our capacity to realize that promise

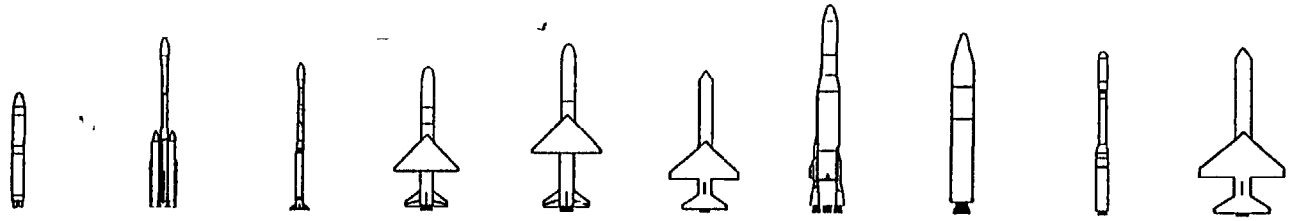
Appendix

Table. Existing and Proposed International Space Transportation Systems

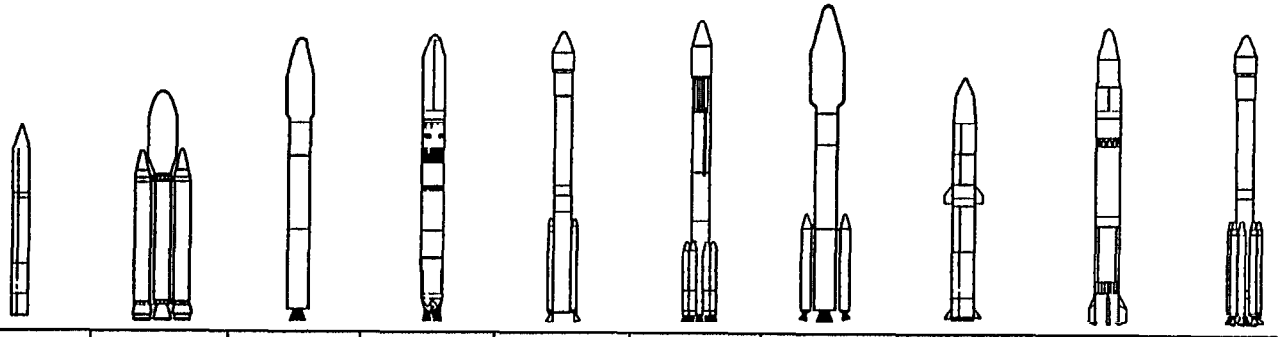
Fact Sheet 1994 National Space Transportation Policy

Table
Existing and Proposed International Space Transportation Systems

Source OTA-ISS-620, p 28-29



Vehicle	Rokot	ASLV	Scout	Pegasus	Pegasus XL	X-34A[c]	Atlas E	LLV1[e]	Taurus	X-34B[c]
Class	Small	Small	Small	Small	Small	Small	Small	Small	Small	Small
Country	Russia	India	U S	U S	U S	U S	U S	U S	U S	U S
lbs to Leo	154[a]	330[b]	560[b]	731[b]	1 021[b]	1,200[d]	1,750[b]	2,000	2,100[b]	2,500[d]
lbs to GEO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A



Vehicle	Kosmos	Conestoga[e]	LLV2[f]	Titan II	Med-Lite[f]	PSLV	LLV3[f]	Tsyklon	LM-2D	Delta II[f]
Class	Small	Small	Small	Small	Small	Medium	Medium	Medium	Medium	Medium
Country	Russia	U S.	U S.	U S	U S	India	U S	Russia	China	U S.
lbs to Leo	3,000	3,300	4,000	4,200	4,790	6,610	8,000	8,800	N/A	11,110
lbs to GEO	N/A	N/A	N/A	N/A	N/A	990	N/A	N/A	2,750	4,010

[a] Demonstrated

[b] Polar Orbit

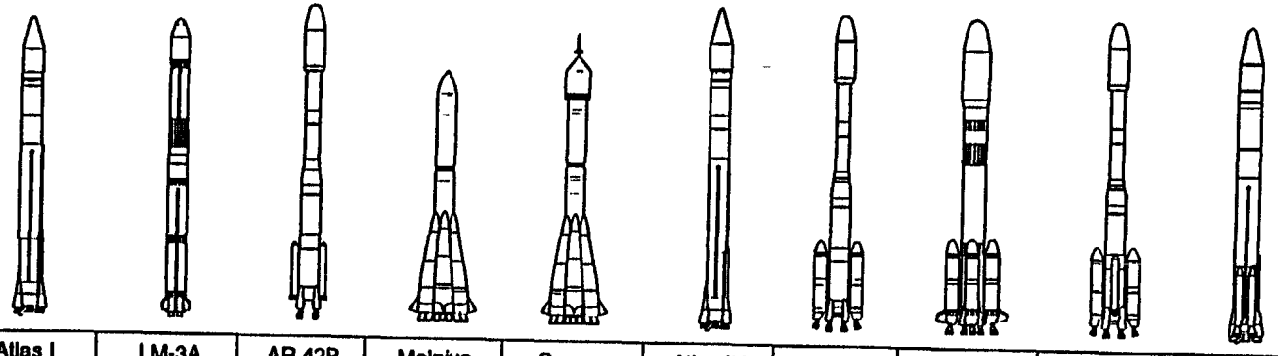
[c] Initially, either the X-34A or X-34B will be developed, not both The X-34 development team, led by Orbital Sciences and Rockwell International, will decide which version of the X-34 to build later in 1995

[d] Orbit of 150 nautical miles (nmi) at an inclination of 28 5

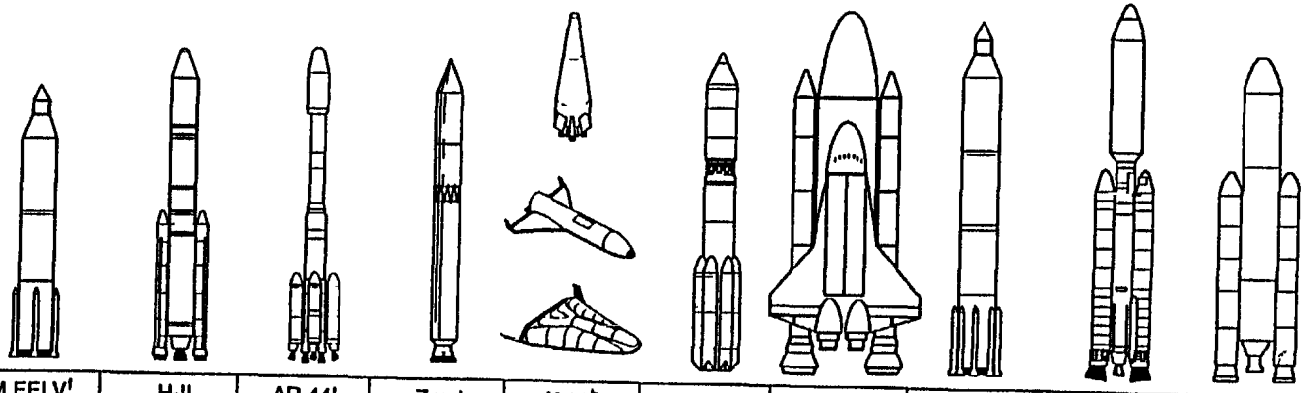
[e] First flight scheduled for 1995

[f] Under development

Existing and Proposed International Space Transportation Systems (continued)



Vehicle	Atlas I	LM-3A	AR 42P	Molniya	Soyuz	Atlas IIA	AR 42L	LM-2E	AR 44LP	Atlas IIAS
Class	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Country	U S	China	France	Russia	Russia	U S	France	China	France	France
lbs to Leo	13,000	15,800	13,200	N/A	15,400	16,050	16,300	19,400	18,300	19,050
lbs to GEO	5,240	5,550	5,730	N/A	N/A	6,970	7,050	7,430	8,160	8,450



Vehicle	M EELV[f]	H-II	AR 44L	Zenit	X-33[h]	Proton	Shuttle	H-EELV[f]	Titan IV	Ariane 5[e]
Class	Medium	Medium	Medium	Medium	Medium	Heavy	Heavy	Heavy	Heavy	Heavy
Country	U S	Japan	France	Russia	U S	Russia	U S	U S	U S	France
lbs to Leo	No Spec[g]	22,040	21,100	30,300	40,000[i]	44,100	53,500	41,000[b]	39,100	44,000
lbs to GEO	No Spec[g]	8,816	9,260	N/A	N/A	12,100	13,000	13,500	14,000	15,000

[g] DOD has not specified payload delivery requirements for the medium EELV The EELV manufacturer could potentially develop more than one medium-sized vehicle to handle the wide range of DOD payloads in the medium payload class

[h] Three development teams led by Lockheed Martin, McDonnell Douglas, and Rockwell International respectively, are conducting preliminary X-33 studies for NASA At present, NASA plans to select one development team in December 1996 to build and test-fly its version of the X-33

[i] This is equivalent to delivering 25,000 lbs to the International Space Station orbit According to NASA, the 25,000 lbs to the International Space Station orbit is for planning purposes only and could be revised as development proceeds

SOURCES Bretton S Alexander et al , *1994 Space Launch Activities* (Arlington, VA ANSER, Jan 1995) *Office of Technology Assessment*, 1995

THE WHITE HOUSE

Office of Science and Technology Policy

For Immediate Release August 5, 1994

FACT SHEET

NATIONAL SPACE TRANSPORTATION POLICY

Introduction

The United States space program is critical to achieving U.S. national security, scientific, technical, commercial, and foreign policy goals. Assuring reliable and affordable access to space through U S. space transportation capabilities is a fundamental goal of the U S space program. In support of this goal, the U.S. Government will

(1) Balance efforts to sustain and modernize existing space transportation capabilities with the need to invest in the development of improved future capabilities;

(2) Maintain a strong space transportation capability and technology base, including launch systems, infrastructure, and support facilities, to meet the national needs for space transport of personnel and payloads;

(3) Promote the reduction in the cost of current space transportation systems while improving their reliability, operability, responsiveness, and safety,

(4) Foster technology development and demonstration to support future decisions on the development of next generation reusable space transportation systems that greatly reduce the cost of access to space,

(5) Encourage the cost-effective use of commercially provided U.S. products and services, to the fullest extent feasible, that meet mission requirements; and

(6) Foster the international competitiveness of the U S. commercial space transportation industry, actively considering commercial needs and factoring them into decisions on improvements in launch facilities and launch vehicles.

This policy will be implemented within the overall resource and policy guidance provided by the President.

I. Implementation Guidelines

To ensure successful implementation of this policy, U.S Government agencies will cooperate to take advantage of the unique capabilities and resources of each agency.

This policy shall be implemented as follows:

(1) The Department of Defense (DoD) will be the lead agency for improvement and evolution of the current U S. expendable launch vehicle (ELV) fleet, including appropriate technology development

(2) The National Aeronautics and Space Administration (NASA) will provide for the improvement of the Space Shuttle system, focusing on reliability, safety, and cost-effectiveness.

(3) The National Aeronautics and Space Administration will be the lead agency for technology development and demonstration for next generation reusable space transportation systems, such as the single-stage-to-orbit concept

(4) The Departments of Transportation and Commerce will be responsible for identifying and promoting innovative types of arrangements between the U S Government and the private sector, as well as State and local governments, that may be used to implement applicable portions of this policy. U.S Government agencies will consider, where appropriate, commitments to the private sector, such as anchor tenancy or termination liability, commensurate with the benefits of such arrangements.

(5) The Department of Defense and the National Aeronautics and Space Administration will plan for the transition between space programs and future launch systems in a manner that ensures continuity of mission capability and accommodates transition costs.

(6) The Department of Defense and the National Aeronautics and Space Administration will combine their expendable launch service requirements into single procurements when such procurements would result in cost savings or are otherwise advantageous to the Government A Memorandum of Agreement will be developed by the Agencies to carry out this policy.

II <u>National Security Space Transportation Guidelines</u>

(1) The Department of Defense will be the launch agent for the national security sector and will maintain the capability to evolve and operate those space transportation systems, infrastructure, and support activities necessary to meet national security requirements

(2) The Department of Defense will be the lead agency for improvement and evolution of the current expendable launch vehicle fleet, including appropriate technology development All significant ELV technology-related development associated with medium and heavy-lift ELVs will be accomplished through the DoD. In coordination with the DoD, NASA will continue to be responsible for implementing changes necessary to meet its mission-unique requirements.

(3) The objective of DoD's effort to improve and evolve current ELVs is to reduce costs while improving reliability, operability, responsiveness, and safety. Consistent with mission requirements, the DoD, in cooperation with the civil and commercial sector, should evolve satellite, payload, and launch vehicle designs to achieve the most cost-effective and affordable integrated satellite, payload, and launch vehicle combination.

(a) ELV improvements and evolution plans will be implemented in cooperation with the Intelligence Community, the National Aeronautics and Space Administration and the Departments of Transportation and Commerce, taking into account, as appropriate, the needs of the commercial space launch sector

(b) The Department of Defense will maintain the Titan IV launch system until a replacement is available.

(4) The Department of Defense, in cooperation with NASA, may use the Space Shuttle to meet national security needs. Launch priority will be provided for national security missions as governed by appropriate NASA/DoD agreements. Launches necessary to preserve and protect human life in space shall have the highest priority except in times of national emergency.

(5) Protection of space transportation capabilities employed for national security purposes will be pursued commensurate with their planned use in crisis and conflict and the threat. Civil and commercial space transportation capabilities identified as critical to national security may be modified at the expense of the requesting agency or department. To the maximum extent possible, these systems, when modified, should retain their normal operational utility.

III. Civil Space Transportation Guidelines

(1) The National Aeronautics and Space Administration will conduct human space flight to exploit the unique capabilities and attributes of human access to space. NASA will continue to maintain the capability to operate the Space Shuttle fleet and associated facilities.

(a) The Space Shuttle will be used only for missions that requires human presence or other unique Shuttle capabilities, or where use of the Shuttle is determined to be important for national security, foreign policy or other compelling purposes.

(b) The National Aeronautics and Space Administration will maintain the Space Shuttle system until a replacement is available.

(c) As future development of a new reusable launch system is anticipated, procurement of additional Space Shuttle orbiters is not planned at this time.

(2) The National Aeronautics and Space Administration will be the lead agency for technology development and demonstration of next generation reusable space transportation systems.

(a) The objective of NASA's technology development and demonstration effort is to support government and private sector decisions by the end of this decade on development of an operational next-generation reusable launch system.

(b) Research shall be focused on technologies to support a decision no later than December 1996 to proceed with a sub-scale flight demonstration which would prove the concept of single-stage-to-orbit.

(c) Technology development and demonstration, including operational concepts, will be implemented in cooperation with related activities in the Department of Defense.

(d) It is envisioned that the private sector could have a significant role in managing the development and operation of a new reusable space transportation system. In anticipation of this role, NASA shall actively involve the private sector in planning and evaluating its launch technology activities.

IV. Commercial Space Transportation Guidelines

(1) The United States Government is committed to encouraging a viable commercial U.S. space transportation industry.

(a) The Departments of Transportation and Commerce will be responsible for identifying and promoting innovative types of arrangements between the U.S. Government and the private sector, as well as State and local governments, that may be used to implement applicable portions of this policy.

(b) The Department of Transportation will license, facilitate, and promote commercial launch operations as set forth in the Commercial Space Launch Act, as amended, and Executive Order 12465. The Department of Transportation will coordinate with the Department of Commerce where appropriate.

(c) U.S. Government agencies shall purchase commercially available U.S. space transportation products and services to the fullest extent feasible that meet mission requirements and shall not conduct activities with commercial application that preclude or deter commercial space activities, except for national security or public safety reasons

(d) The U.S. Government will provide for the timely transfer to the private sector of unclassified Government-developed space transportation technologies in such a manner as to protect their commercial value.

(e) The U S. Government will make all reasonable efforts to provide stable and predictable access to appropriate space transportation-related hardware, facilities, and services, these will be on a reimbursable basis. The U S. Government reserves the right to use such facilities and services on a priority basis to meet national security and critical civil sector mission requirements.

(f) U.S. Government agencies shall work with the U.S. commercial space sector to promote the establishment of technical standards for commercial space products and services.

(2) U.S. Government agencies, in acquiring space launch-related capabilities, will, to the extent feasible and consistent with mission requirements:

(a) Involve the private sector in the design and development of space transportation capabilities and encourage private sector financing, as appropriate.

(b) Emphasize procurement strategies that are based on the use of commercial U.S. space transportation products and services.

(c) Provide for private sector retention of technical data rights, limited only to the extent necessary to meet government needs.

(d) Encourage private sector and State and local government investment and participation in the development and improvement of U S. launch systems and infrastructure

V. Trade in Commercial Space Launch Service

(1) A long term goal of the United States is to achieve free and fair trade. In pursuit of this goal, the U.S. Government will seek to negotiate and implement agreements with other nations that define principles of free and fair trade for commercial space launch services, limit certain government supports and unfair practices in the international market, and establish criteria regarding participation by space launch industries in countries in transition from a non-market to a market economy.

(a) International space launch trade agreements in which the U.S. is a party must allow for effective means of enforcement. The range of options available to the U.S. must be sufficient to deter and, if necessary, respond to non-compliance and provide effective relief to the U.S. commercial space launch industry. Agreements must not constrain the ability of the United States to take any action consistent with U.S. laws and regulations.

(b) International space launch trade agreements in which the U.S. is party must be in conformity with U.S. obligations under arms control agreements, U.S. nonproliferation policies, U.S. technology transfer policies, and U.S. policies regarding observance of the Guidelines and Annex of the Missile Technology Control Regime (MTCR).

VI. Use of Foreign Launch Vehicles, Components, and Technologies

(1) For the foreseeable future, the United States Government payloads will be launched on space launch vehicles manufactured in the United States, unless exempted by the President or his designated representative.

(a) This policy does not apply to use of foreign launch vehicles on a no-exchange-of-funds basis to support the following: flight of scientific instruments on foreign spacecraft, international scientific programs, or other cooperative government-to-government programs Such use will be subject to interagency coordination procedures.

(2) The U.S. Government will seek to take advantage of foreign components or technologies in upgrading U.S. space transportation systems or developing next generation space transportation systems. Such activities will be consistent with U.S. nonproliferation, national security, and foreign policy goals and commitments as well as the commercial sector guidelines contained in this policy. They will also be conducted in a manner consistent with U.S. obligations under the MTCR and with due consideration given to dependence on foreign sources and national security.

VII. Use of U.S. Excess Ballistic Missile Assets

(1) U.S. excess ballistic missile assets that will be eliminated under the START agreements shall either be retained for government use or be destroyed. These assets may be used within the U.S. Government in accordance with established DoD procedures, for any purpose except to launch payloads into orbit. Requests from with the Department of Defense or from other U S. Government agencies to use these assets for launching payloads into orbit will be considered by DoD on a case-by-case basis and require approval by the Secretary of Defense.

Mindful of the policy's guidance that U.S. Government agencies shall purchase commercially available U.S. Space transportation products and services to the fullest extent feasible, use of excess ballistic missile assets may be permitted for launching payloads into orbit when the following condition are met·

(a) The payload supports the sponsoring agency's mission.

(b) The use of excess ballistic missile assets is consistent with international obligations, including the MTCR guidelines and the START agreements.

(c) The sponsoring agency must certify the use of excess ballistic missile assets results in a cost savings to the U S. Government relative to the use of available commercial launch services that would also meet mission requirements, including performance, schedule, and risk.

VIII. Implementing Actions

(1) Within 90 days of approval of this directive, United States Government agencies are directed to prepare the following for submission to the Assistant to the President for Science and Technology and the Assistant to the President for National Security Affairs:

(a) The Secretaries of Defense, Commerce, Transportation, and the Administrator of the National Aeronautics and Space Administration, with appropriate input from the Director of Central Intelligence, will provide a report that will include a common set of requirements and a coordinated technology plan that addresses the needs of the national security, civilian, and commercial space launch sectors.

(b) The Secretary of Defense, with the support of other agencies as required, will provide an implementation plan that includes schedule and funding for improvement and evolution of the current U.S. ELV fleet

(c) The Administrator of the National Aeronautics and Space Administration, with the support of other agencies as required, will provide an implementation plan that includes schedule and funding for improvements of the Space Shuttle system and technology development and demonstration for next generation reusable space transportation systems.

(d) The Secretaries of Transportation and Commerce, with the support of other agencies as required and U S. industry, will provide an implementation plan that will focus on measures to foster an internationally competitive U S. launch capability. In addition, the Secretaries will provide recommendations to the Department of Defense and the National Aeronautics and Space Administration that promote the full involvement of the commercial sector in the NASA and DoD plans.

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